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(54) Reamer.

(57) The present invention provides a reamer 1 suitable for use in pipework 2 having at least two different internal diameters in a section thereof. The reamer 1 comprises an elongate body 4 formed and arranged for passing through a reduced diameter portion of said pipework 2 and has cutting member supports 6 with fixed pivotal mountings for a cutting member 8 for pivotal movement thereof between a retracted position and a deployed position extending radially outwardly of the body 4. The body 4 also has cutting member drive means 10 which engages part 22 of the cutting member 8 for displacement of the cutting member 8 between its retracted and deployed positions and substantially securely supporting the cutting member 8 in its deployed condition against angular displacement in the plane of pivotal movement about the pivotal mounting means.

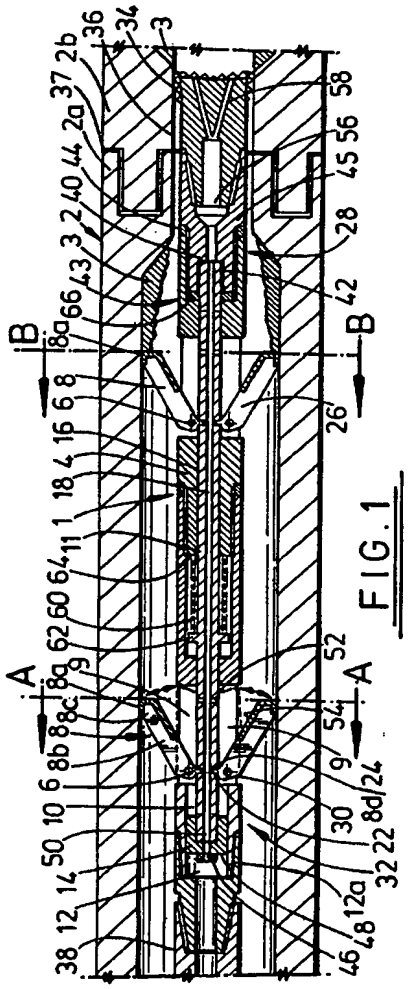

FIG. 1

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The present invention relates to a reamer suitable for use in removing the build up of deposits that can accumulate within the bore of oil well pipes. The reamer is particularly intended for "down-hole" use.

Oil well pipes or tubing through which crude oil passes form deposits inside the bores of the pipes. Consequently as the thickness of the deposit increases the rate of flow of oil through the pipes is significantly reduced. The deposits that build up form an extremely hard, rock like layer that is particularly difficult to remove. Presently conventional reamers are used to remove the build up of deposits but most oil well pipe sections have an internal stepped portion at the each end of the pipe to facilitate connection of pipe sections which results, when pipes are joined together, in there being localised portions within the bore of the pipe which have a reduced diameter in comparison to the main portion of the pipe section. It will therefore be understood that a conventional generally fixed diameter reamer is unsuitable for removing all or substantially all of the deposits in the main portion of the pipe as it is not possible for the reamer to pass through the localised reduced diameter portions where pipe sections are connected or if it's diameter is small enough to pass, then it cannot fully clear the deposits between successive constrictions. Reamers having effectively variable diameters by utilising retractable cutting blades have previously been proposed but have not proved very successful as the deposits that are removed from the pipe wall end up as a debris which clog the retraction mechanism and prevent retraction of the cutting blades. Furthermore the linkage used to support the blades can swing laterally into an off-centre position resulting in the cutting blades cutting incorrectly or not cutting at all, and/or possibly becoming damaged or jammed.

It is an object of the present invention to avoid or minimise one or more of the above disadvantages.

The present invention provides a reamer suitable for use in pipework having at least two different internal diameters in a section thereof, said reamer comprising an elongate body formed and arranged for passing through a reduced diameter portion of said pipework, said body having cutting member support means comprising a substantially fixed pivotal mounting means for supporting a cutting member for pivotal movement between a first retracted position and a second deployed position extending generally radially outwardly of said body, said body also mounting a cutting member drive means formed and arranged for positive driving engagement with an engagement portion of said cutting member for displacement of said cutting member between its retracted and deployed positions and substantially securely supporting the cutting member in its deployed condition against angular displacement in the plane of pivotal movement about said pivotal mounting means.

Thus the present invention provides a reamer of relatively simple and economic construction which can ream out successive lengths of pipework to different diameters, and is relatively reliable in operation.

Advantageously the cutting member drive means has a drive member mounted in said body so as to be displacable generally axially thereof. Various suitable forms of positive engagement may be provided between the drive means and the cutting member for positive displacement of the cutting member both towards it deployed position and towards its retracted position, and to support the cutting member against retraction or deployment (or further retraction or deployment) in any given position of the drive means. Thus there may be provided, an actual connection between the drive means and the cutting member "tying" them together, or given that the movement of the parts is suitably constrained (by guide means etc.) there may simply be a camming or like interengagement e.g. a rack-and-pinion form of interengagement with one of the cutting member and a drive member provided with pinion or tooth means and the other provided with rack or slot means formed and arranged for positive driving interengagement therewith.

In general the drive means is formed and arranged so that a drive member thereof is remotely operable, conveniently via a pressurised fluid circuit. Preferably there is used a drive member provided with a piston means mounted in a cylinder means for displacement by pressurised fluid introduced into said cylinder means. If desired there may be used a double-acting piston and cylinder means. Other arrangements may also be used though e.g. with resilient biasing means such as a helical spring means for return movement of the drive member e.g. towards a cutting member retracting position thereof.

Preferably said cutting member is provided with secondary support means in the form of longitudinally extending slots in said body within which said cutting member may be substantially retracted. Conveniently the cutting members are a more or less loose sliding fit within the slots. In use, with said cutting members in a said deployed position, said support means abut at least one side face of said cutting member thereby substantially reducing the possibility of relative angular movement of said cutting member with respect to said body.

Preferably said cutting member drive means is provided with a lubrication fluid distribution means, conveniently via said pressurised fluid circuit and which means comprising an inlet means, at least one outlet means and connecting passage means, the lubrication fluid distribution means being used to lubricate said cutting member. Advantageously said lubrication fluid distribution means is also formed and arranged to direct fluid through the slots thereby substantially to reduce the build up of cuttings and other

debris tending to enter the slots around said cutting members.

Preferably said cutting member drive means and said body are provided with mounting means formed and arranged substantially to prevent rotational displacement of said body with respect to said cutting member drive means whereby said fluid distribution outlet means remain in alignment with said slots and also to facilitate the transfer of torque from said body to the cutting members.

Preferably said reamer is provided with a centralised cutting means such as a conventional diamond drilling bit, connected to a leading front end of said body, said cutting means being generally formed and arranged for removing accumulated deposits, inside of a pipe, to a diameter not greater than the smallest of the internal diameters of the pipe or pipework.

Preferably said reamer is provided with a rotary drive means for rotating the cutting member support means about a central longitudinal axis thereof so that the cutting member describes a generally circular path.

Various suitable forms of rotary drive means may be used but preferably a pressurised fluid rotary drive means is used, e.g. a wing motor such as that disclosed in International Patent Publication No. WO90/09510.

Preferably said reamer is provided with first and second cutting member means spaced apart longitudinally of the reamer e.g. with a first pair of diametrically opposed cutting members proximal the leading front end of said reamer and a second pair of diametrically opposed cutting members proximal a trailing rear end of said reamer. Advantageously the cutting members of the first and second cutting member means are angularly offset, e.g. by about 90°, so that in use of said reamer in a pipe, said body is supported against the interior sides of the pipe and any deposit thereon, in a generally concentric orientation with respect to the longitudinal axis of said pipe.

Further preferred features and advantages of the present invention will appear from the following detailed description given by way of example of a preferred embodiment illustrated with reference to the accompanying drawings in which:-

Fig. 1 is a longitudinal cross-section through a reamer of the invention;

Fig. 2 is a first transverse section in the direction of line A-A of the reamer in Fig.1; and

Fig. 3 is a second transverse section in the direction of line B-B of the reamer in Fig. 1.

A reamer, generally indicated by reference number 1, suitable for use in a section of pipe 2 in which deposits 3 have accumulated, comprises a tubular body 4 provided with pivotal support mounts 6 for supporting cutting members 8. The cutting members 8 and the cutting elements 8a thereof are movable between a retracted position (shown in broken line) inside slots 9 in the body 4 and a deployed position, by the action of a cutting member drive means 10 mounted inside said shaft 4. The cutting member drive means 10 is actuated by admitting pressurised fluid (not shown) into a cylinder 12 housing a piston 14 attached to one end of an elongate shaft 11 of the cutting member drive means 10.

In more detail, the body 4 has an elongate bore 16 running through the centre 18 thereof in which is slidably mounted the cutting member drive shaft 11. The cutting member drive shaft 11 connects the piston 14 to the cutting members 8 via radially inwardly extending slots 22 for positive driving engagement with teeth 24 on the cutting members 8.

As may be seen in Fig. 1 each cutting member 8 is effectively in the form of a bell crank lever with one elongate arm 8b mounting the cutting elements 8a at its distal end portion 8c, and the other arm 8d constituted by a said tooth 24, so that axial displacement of the cutting member drive shaft 11 results in angular displacement of the cutting member 8 about its pivotal mounting 6 between its retracted and deployed positions.

In the embodiment herein described the reamer 1 is provided with a first pair 26 of diametrically opposed cutting members 8 towards a leading front end 28 of the reamer 1 and a second pair 30 of diametrically opposed cutting members 8 towards a trailing rear end 32 of the reamer 1. For convenience the present embodiment shows the first and second pairs 26, 30 of the cutting members 8 to have a similar angular disposition on the body 4. In practice the first and second pairs 26, 30 of cutting members 8 are angularly offset by 90°as shown in Figs. 2 and 3 for improved orientation and support in use of the reamer 1 in the pipe 2.

The reamer is also provided with a front end 28 drill bit 34 having an effective drilling diameter not greater than the minimum diameter of the pipe 2 bore 36 where two sections 2a, 2b of pipe 2 are jointed together 37. The drill bit 34 is designed to remove any deposits 3 from the pipe 2 radially inwardly of the reduced diameter pipe section 2a, 2b so as to allow the reamer 1 to pass therethrough with the cutting members 8 in their retracted position.

In operation of the reamer 1, pressurised fluid (not shown) is admitted into the cylinder 12 containing the piston 14. The pressurised fluid is supplied to the reamer 1 by a pipe 38 connected to a remote pressurised fluid supply (not shown). As the pressurised fluid is admitted into the cylinder 12, the piston 14 moves down the bore 12a of the cylinder 12 thereby axially displacing the cutting member drive shaft 11 to which it is attached. The lateral movement of the drive shaft 11 is converted via the tooth 24 - slot 22 connection to angular displacement of the cutting member 8 and the cutting tool 8a attached thereto.

The stroke of the piston 14 and the drive shaft 11

and hence the angular rotation of the cutting members 8 is limited by an end stop 40 in the body 4 at the leading end 42 of the cutting member drive shaft 11 from the piston 14. The position of the end stop 40 with respect to the body 4 may be adjusted by introducing spacers 44 between the leading end 43 of the body 4 and drill bit 34 mounting portion 45. If will therefore be understood that the effective reamer diameter may be adjusted to suit pipes of different internal bores by using differently sized spacers 44.

Furthermore it will be seen that the piston 14 has a restrictor valve 46 in the crown 48 thereof for admitting pressurized fluid into a fluid line 50 inside the cutting member drive shaft 11. The fluid line 50 has outlet nozzles 52 adjacent the underside 54 of the cutting members 8 so that any cutting debris present in this area which could obstruct retraction of the cutting members 8 into the body 4, is expelled by the flow of fluid exiting the outlet nozzles 52. Pressurized fluid also travels through the cutting member drive shaft 11 to the base 56 of the drill bit 34 through which it passes, via small apertures 58, to act as a coolant and lubricant for the drill bit 34.

The cutting member drive shaft 11 is also provided with a compression spring 60 mounted circumferentially therearound. The spring 60 extends between a collar 62 on the drive shaft 11 and an internal end face 64 inside the body 4. In the absence of pressurized fluid, for instance due to a failure of the supply, the spring 60 acts between the drive shaft 11 and the body 4 so as to retract the cutting members 8 inside the slots 9 in the reamer body 4 thereby enabling the reamer 1 to be readily recovered from inside the pipework.

The leading end 42 of the cutting member drive shaft 11 is polygonal in section and is slidably mounted in a generally complementary mounting plate 66, rigidly attached between the drill bit mounting portion 45 and the leading end 43 of the body 4. The polygonal section of the drive shaft 11 and mounting plate 66 prevents rotation of the drive shaft 11 relative to the reamer body 4 so that upon rotation of the reamer body 4 by a wing motor or the like, adequate torque is transmitted to the cutting members 8 during reaming.

It will be appreciated that various modifications may be made to the above described embodiment without departing from the scope of the present invention. Thus, for example, further pairs of cutting members may be incorporated, conveniently with successive pairs of cutting members formed and arranged for reaming at progressively greater diameters for cutting away the deposits incrementally.

Claims

1. A reamer (1) suitable for use in pipework (2) having at least two different internal diameters in a section thereof, said reamer (1) comprising an elongate body (4) formed and arranged for passing through a reduced diameter portion of said pipework (2), said body (4) having cutting member support means (6) comprising a substantially fixed pivotal mounting means for supporting a cutting member (8) for pivotal movement between a first retracted position and a second deployed position extending generally radially outwardly of said body (4), said body (4) also mounting a cutting member drive means (10) formed and arranged for positive driving engagement with an engagement portion (22) of said cutting member (8) for displacement of said cutting member (8) between its retracted and deployed positions and substantially securely supporting the cutting member (8) in its deployed condition against angular displacement in the plane of pivotal movement about said pivotal mounting means.

2. A reamer according to claim 1 wherein the cutting member drive means (10) has a drive member (11) mounted in said body (4) so as to be displacable generally axially thereof.

3. A reamer according to claim 1 or claim 2 wherein the drive means (10) is formed and arranged so that a drive member (11) thereof is remotely operable, via a pressurised fluid circuit (38).

4. A reamer according to claim 3 wherein is used a drive member (11) provided with a piston means (14) mounted in a cylinder means (12) for displacement by pressurised fluid introduced into said cylinder means (12).

5. A reamer according to any one of claims 1 to 4 wherein said cutting member (8) is provided with secondary support means in the form of longitudinally extending slots (9) in said body within which said cutting member (8) may be substantially retracted.

6. A reamer according to claim 5 wherein said cutting member drive means (10) and said body (4) are provided with mounting means (42, 66) formed and arranged substantially to prevent rotational displacement of said body (4) with respect to said cutting member drive means (10) whereby said fluid distribution outlet means remain in alignment with said slots (9) and also to facilitate the transfer of torque from said body (4) to the cutting members (8).

7. A reamer according to any one of claims 1 to 6 is provided with a centralised cutting means (34),

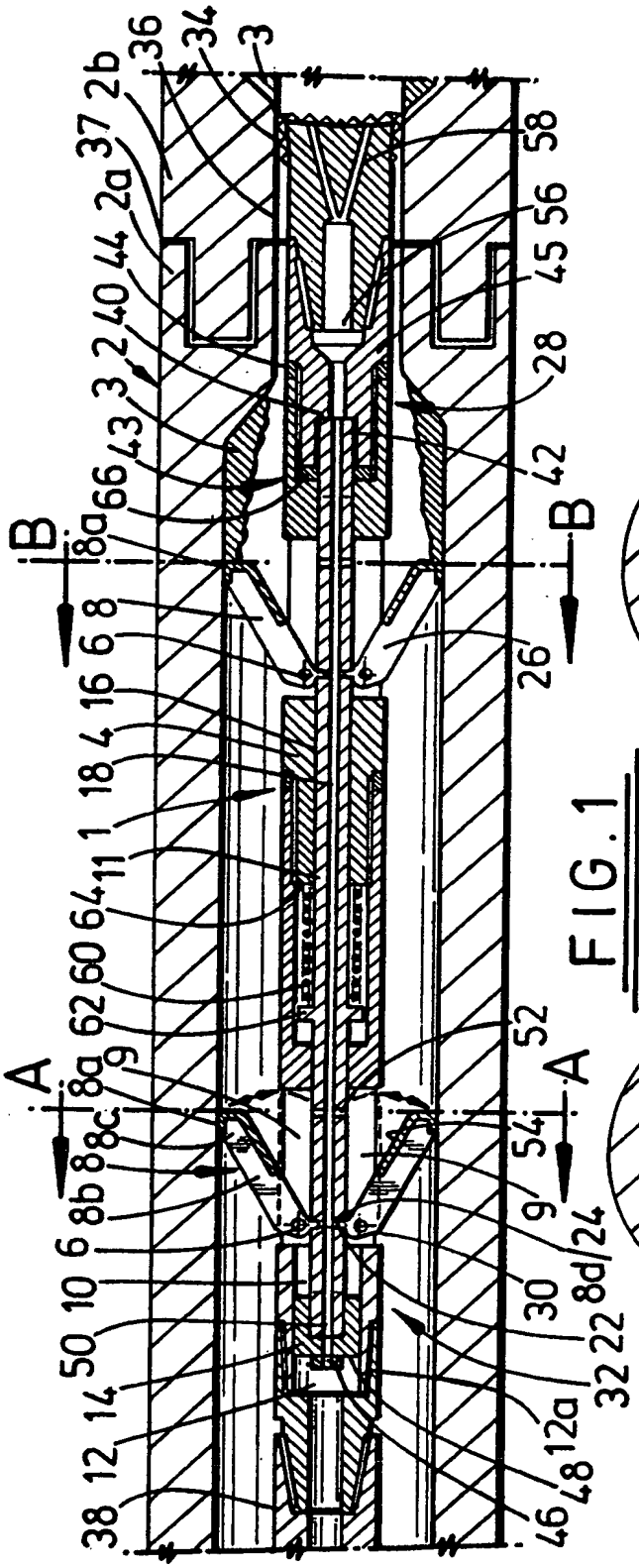

FIG. 1

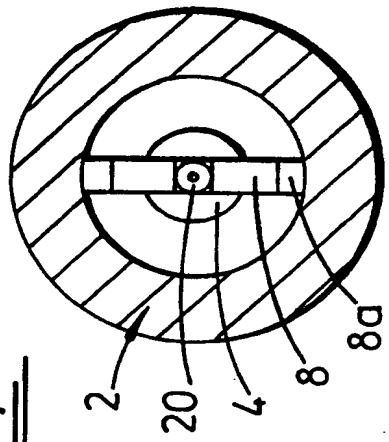

FIG. 3

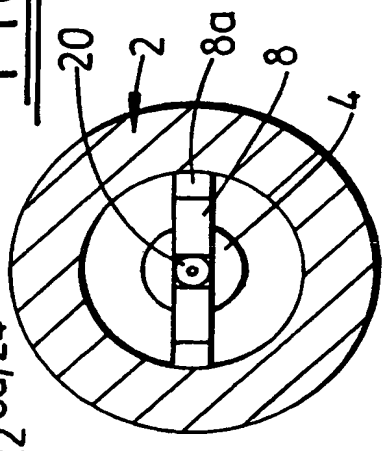

FIG. 2

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 93 30 3215

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
X	US-A-4 809 793 (HAILEY) * column 4, line 26 - column 10, line 33; figures *	1-5,7-10	E21B37/02 E21B10/32
X	US-A-2 756 968 (EMANUEL ET AL.) * column 2, line 34 - column 4, line 14; figures *	1-5,7,8	
X	US-A-4 838 354 (JENKINS) * column 3, line 32 - column 4, line 65; figures *	1-5,7,8	
A	US-A-3 351 144 (PARK) * column 2, line 1 - line 59; figures 1,2 *	1-6,8	
A	US-A-5 036 921 (PITTARD ET AL.) * column 9, line 31 - column 10, line 5; figures *	1-5,8-10	
			TECHNICAL FIELDS SEARCHED (Int. Cl.5) E21B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	22 JULY 1993	LINGUA D.G.

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